FOUNDRY TRADE JOURNAL
Established 1903
WITH WHICH IS INCORPORATED THE IRON AND STEEL TRADES JOURNAL

Vol. 75 Thursday, March 8, 1945 No. 1490

An Approach to the Waster Problem

If one perused the 1,500 odd issues of this JOURNAL, one would be impressed by the ever-increasing candour of writers on foundry practice as to the wasters they have made, until to-day quite reprehensible "bloomers" are candidly admitted. Periodically there have appeared articles of great value and the application of the information given therein would have prevented the making of such mistakes. Even if back copies of the JOURNAL were easily available, it would be a Herculean task to sift the wheat from the chaff—for both exist, sometimes in contiguous paragraphs!

The periodic publication of text-books does much to effect this objective, yet despite all this published information obviously avoidable wasters are still being made. Shop tradition and practice unintelligently applied to fresh jobs seem to be the worst features. It is obvious that, from time to time, some interesting innovation, such as the pencil runner, is described. Immediately its worth is recognised, but not its limitations, with the result it assumes in some shops an exaggerated importance as a means of making sound castings. To-day, there is a wide choice of running methods, all of which are excellent if properly applied. Each one is known to satisfy certain conditions, such as, for instance, the outstanding necessity for directional solidification, but what is too seldom realised is that in a complicated casting there must be a combination of running methods so designed that to each part the most suitable system is applied. What, years ago, was the most difficult to control in foundry practice has now become in up-to-date organisations a matter of routine. Thus the foundryman can be assured in such concerns that he will receive metal of the correct composition and at the most suitable temperature. Moreover, he is in a position to modify within a wide range the physical properties of the moulding sands and to standardise on a minimum number of mixtures quite adequate for controlled production.

When manufacturing large quantities of light components, it is usual to put through a pilot casting, which once having proved itself, standardised production can be achieved. For the jobbing foundry, the pilot casting is impracticable, and therefore much more fundamental knowledge is a requisite and must be applied if first attempts at production are to be successful. Much of this fundamental knowledge is bound up with an elementary study of hydrostatics.

Whilst there should be no wasters due to the insufficient weighting of moulds, break-outs at mould bottoms, core shifts due to floating, expansion of core irons and grids, and the like, there is at the moment insufficient basic knowledge as to the provision of running systems for every type of mould which will ensure an indisputably sound casting. Herein the skill and experience of the moulder are still essential. His art, however, can be aided and his output increased by the publication of all systematic data on the subject. Much has already been made available, and more is forthcoming. By extending knowledge of the subject, the production of the most complicated castings will be facilitated and the field of the foundry consolidated and extended.

BAUXITE PROPERTIES in Jamaica have been acquired by the Aluminium Company of Canada. They will supplement the British Guiana ores on which the Canadian aluminium industry has largely depended heretofore.

THE "IRON AGE" representative in Washington reports that he has been officially informed that recent demands, covering the first six months of this year, for aluminium are likely to change what was considered to be an "easy" market for this metal.

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CORRESPONDENCE

[We accept no responsibility for the statements made or the opinions expressed by our correspondents.]

"AN APPEAL TO YOUTH"

To the Editor of THE FOUNDRY TRADE JOURNAL.

SIR,—I read with considerable interest your leader of February 15 on "An Appeal to Youth." This Association is much exercised on this topic and what seems to be desirable is to get juvenile committees on our side a bit more than they have been in the past. Many of these bodies appear to think that the factories are most unhealthy and unsuitable places for young persons to work in, and whilst that may or may not have been the case once upon a time, it is certainly not true of the vast majority of factories to-day.

It is, therefore, most desirable that all factory industry associations direct their thoughts towards educating Juvenile Employment Committees into a better understanding of the conditions which we are able to offer to youth.—Yours, etc.,

EDGAR N. HILEY,
Secretary,
National Brassfoundry Association.

106, Edmund Street,
Birmingham, 3.
February 26, 1945.

FOUNDRY TECHNICAL TRAINING IN AUSTRALIA

To the Editor of THE FOUNDRY TRADE JOURNAL.

SIR,—Among the various foundry activities at the Melbourne Technical College is the provision for educational extension lectures each year. Specialists in each branch are selected as lecturers, and a series dealing with foundry engineering has just been completed. The following subjects were included in the series of lectures for 1944:—Pneumatic equipment; welding, and flame cutting in the foundry; fuel oil and its applications; foundry management; foundry heating and melting units; illumination; application of moulding machines; and sand reconditioning and power transmission.

Educational extension lectures of this nature receive excellent support from technical societies and past students of the College.—Yours, etc.,

FRANK ELLIS,
Principal.

Melbourne Technical College,
124, Latrobe Street,
Melbourne, Australia.,
December 20, 1944.

PRODUCTION OF commercial steel castings, as reported by the U.S. Bureau of Census, Department of Commerce, continues to expand. The production for the first six months of 1944 was 970,785 net tons, or 161,797 tons per month. This compares with 160,720 tons and 139,931 tons per month for all of 1943 and 1942 respectively. The June output was 157,444 tons, with 174,626 tons in March, the largest for the first half.

FORTHCOMING EVENTS

(Secretaries are invited to send in notices of meetings, etc., for inclusion in this column.)

MARCH 10.

Keighley Association of Engineers:—Annual dinner, at 5.30 p.m., at which the guest of honour will be Sir Miles Thomas, D.F.C., vice-chairman of the Nuffield organisation.

MARCH 16.

Institution of Mechanical Engineers:—Informal meeting. "Invention After the War," to be introduced by Harold Sinclair, M.I.MechE., E. W. Moss, M.I.Mech.E., and H. W. Cadman, M.I.Mech.E. At Storey's Gate, St. James's Park, London, S.W.1, at 5.30 p.m.

MARCH 17.

Institution of Mechanical Engineers:—Graduates' Section, London, annual lecture. "British Machine Tools During the War," by A. H. Lloyd, B.Sc., M.I.Mech.E. At Storey's Gate, St. James's Park, London, S.W.1, at 3.30 p.m.

MARCH 23.

Manchester Association of Engineers:—Annual general meeting, followed by Paper on "Gear Cutting," by A. S. Rowley, B.Sc.Tech. At the Engineers' Club, Albert Square, Manchester, at 6.30 p.m.

MARCH 24.

Sheffield Metallurgical Association:—Joint meeting with the South Yorkshire Section of the Royal Institute of Chemistry. "The Principles Governing Corrosion Resistance in Metals and Alloys," by Dr. U. R. Evans. At the Sheffield Metallurgical Club, 198, West Street, Sheffield, 1, at 2.30 p.m.

Institute of British Foundrymen

MARCH 10.

Bristol Branch:—"The Production and Properties of High Strength Cast Irons," by A. E. McRae Smith. At the Grand Hotel, Broad Street, Bristol, at 3 p.m.

West Riding of Yorkshire Branch:—Prize-winning Paper in the S. W. Wise Competition. At the Technical College, Bradford, at 6.30 p.m.

MARCH 16.

Middlesbrough Branch:—"Modification by Heat-treatment of Cast Structures and Properties," by Dr. H. T. Angus. At the Cleveland Technical Institute, Corporation Road, Middlesbrough, at 7.45 p.m.

MARCH 23.

Middlesbrough Branch:—Annual general meeting, followed by a report on the activities of the Technical Council and Sub-Committees by J. E. Mercer. At the Cleveland Technical Institute, Corporation Road, Middlesbrough, at 8 p.m.

MARCH 24.

Birmingham Branch:—"Malleable Cast Iron," by A. E. Peace. At the James Watt Institute, Great Charles Street, Birmingham, at 2.30 p.m.

East Midlands Branch:—Annual meeting. Short Paper Competition. At the Technical College, Derby, at 6 p.m.

MARCH 26.

Sheffield Branch:—Joint meeting with the Iron and Steel Institute. Discussion of the Report of the Foundry Practice Sub-Committee. At the Royal Victoria Hotel, Sheffield, at 7 p.m.

MARCH 28.

London Branch:—"Gating, Risering and Chilling of Magnesium Castings," by A. Cristello. Exchange Paper from the Metropolitan Chapter of the American Foundrymen's Association. At the Charing Cross Hotel, London, W.C.2, at 7.30 p.m.

APRIL 7.

Wales and Monmouth Branch:—Works visit to the Tubal Cain Foundry and Engineering Works, Limited, Cardiff, at 2.45 p.m. Followed by a lecture at the works on "Phosphor-bronze Worm Wheel Blanks," by A. Hopwood.

SOME HIGH-TENSILE ALUMINIUM CASTING ALLOYS*

By J. MORGAN

Wartime research should facilitate post-war expansion

[ABSTRACT]

A fairly recent series of alloys which enjoy a moderate popularity are those of aluminium and silicon. The addition of silicon to aluminium improves its properties for casting purposes, raises the strength without rendering the alloys brittle and decreases the density. Aluminium silicon alloys are exceptionally fluid and give sharper impressions of intricate moulds than almost any other aluminium alloy. When melted and cast in the normal manner, the alloys exhibit no outstanding properties, but, if subjected to the process of modification, the structure of the alloys undergoes a change and a beneficial effect on the properties is produced. For instance, a sand-cast sample of an unmodified 11 per cent. silicon alloy may have a tensile strength of 8 tons per sq. in. with an elongation of 1½ per cent., but after suitable modification no difficulty should be encountered in producing bars which in the "as-cast" state will have a tensile strength of 12½ tons per sq. in. with an elongation figure of up to 10 per cent.

By modification is meant the addition of a small controlled amount of sodium to the melt. This may be carried out by means of adding metallic sodium to the molten metal prior to pouring or by stirring the molten metal with fluid fluxes containing salts of sodium and other modifying agents. Metallic sodium is all very well for metal which is to be used in the production of die castings, but for sand castings the flux method is very superior, especially where the castings have to pass radiological examination; metallic sodium appears to render the castings porous. Figs. 1 and 2 show the effect of modifying on the microstructure of this alloy.

With the further additions of small amounts of other elements, this interesting series of alloys becomes susceptible to heat-treatment, which further improves the properties, although in some cases, such as the addition of copper, the addition seems to affect the modify-

* A Paper read before the Wales and Monmouth Branch of the Institute of British Foundrymen at the conclusion of a visit to the works of the Northern Aluminium Company, Limited, Mr. H. G. T. Williams presiding.

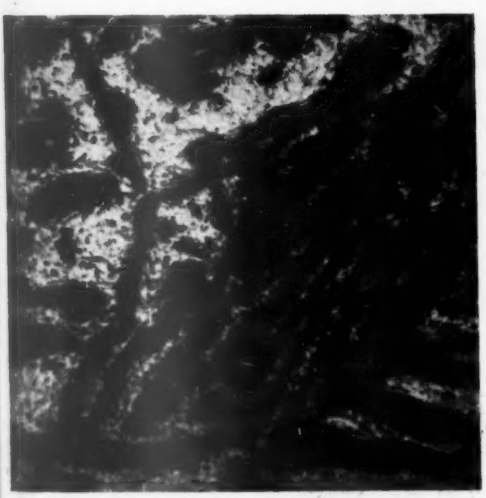

FIG. 1.—SILICON IN L33 UNMODIFIED STRUCTURE. × 300.

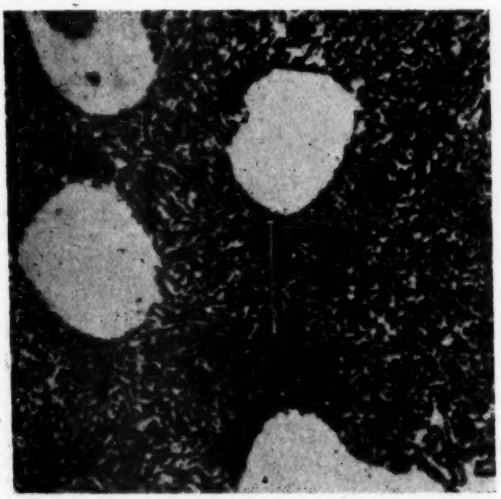

FIG. 2.—SILICON IN L33 CORRECTLY MODIFIED STRUCTURE. × 300.

Aluminium Casting Alloys

ing and probably accounts for a drop in tensile strength when added to the 13 per cent. silicon alloys. Copper has not the same effect on alloys containing a lower amount of silicon, as it is added in order to improve both the tensile figures and machinability.

DTD 245

One of these addition alloys is known as "Alpax gamma," and conforms to Air Ministry specification DTD 245. In addition to the 10 to 13 per cent. silicon, it contains 0.6 per cent. each of iron, manganese and magnesium, the magnesium conferring on the alloy the property of age-hardening by the formation of a compound, magnesium silicide, within the alloy.

The strength of aluminium alloys cannot be improved by means of heat-treatment unless there is a constituent present which will enter into solid solution in the alloy as the temperature is increased. Two metallic compounds, copper aluminium ($CuAl_2$) and magnesium silicide (Mg_2Si), possess this property and are therefore the bases of most aluminium alloys which are susceptible to heat-treatment. Usually, the first process is to get as much as possible of these compounds into solid solution in the primary metal by soaking it at a temperature just below the melting point of the alloy and then retaining the solution so obtained by means of quenching. From this state some aluminium alloys such as Duralumin and "Y" alloy age harden naturally in the course of a day or so at room temperature by the precipitation of the compound in solution in a very finely divided form along the grain boundaries. In other alloys the precipitation must be assisted by heating at a comparatively low temperature before the properties available can be exploited. Some of the precipitates are not detectable even under the microscope. The whole process is affected by the grain size of the castings, a fine grain allowing the processes to take place more rapidly and completely.

The usual heat-treatment of "Alpax gamma" consists of heating for up to 4 hrs. at a temperature of 500 deg. C. and quenching in water. This is followed by a low-temperature treatment at 160 deg. C. The resultant tensile strength is in the region of 17 to 18 tons per sq. in., the specification minimum being 15.5 tons per sq. in.

DTD 424

A rather remarkable alloy—the one which conforms to the specification DTD 424—can scarcely be classed as a high-tensile aluminium alloy, because it is made from secondary materials. It has long been supposed that secondary aluminium alloys are inferior to those made from virgin ingot, but this is at least one case where that contention is not true. The alloy is made up from scrap material of three other alloys, "Y" alloy, Alpax or B.S.S. L33, and Duralumin. The composition is as follows:—Silicon, 3 to 6 per cent.; copper, 2 to 4; iron, 0.8 max.; manganese, 0.7 max.; and magnesium, 0.5 per cent. max. As the ranges of the composition are rather wide, a large variation of properties is possible by varying the composition within the specification limits. Generally speaking, how-

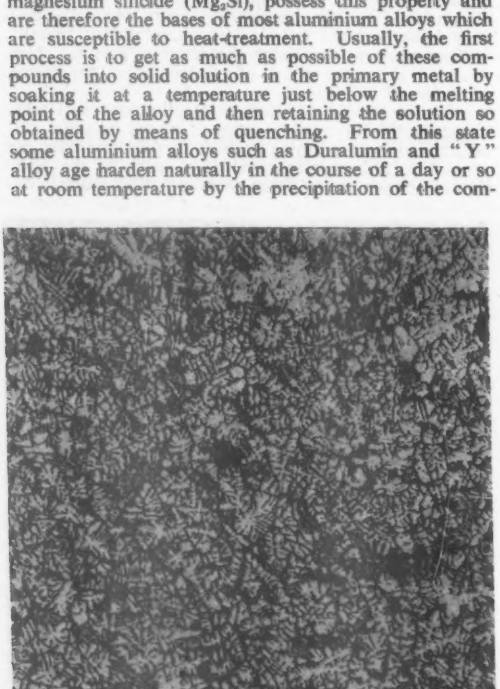

FIG. 3.—STRUCTURE OF DTD 424 AFTER FLUX MODIFICATION. UNETCHED. × 40.

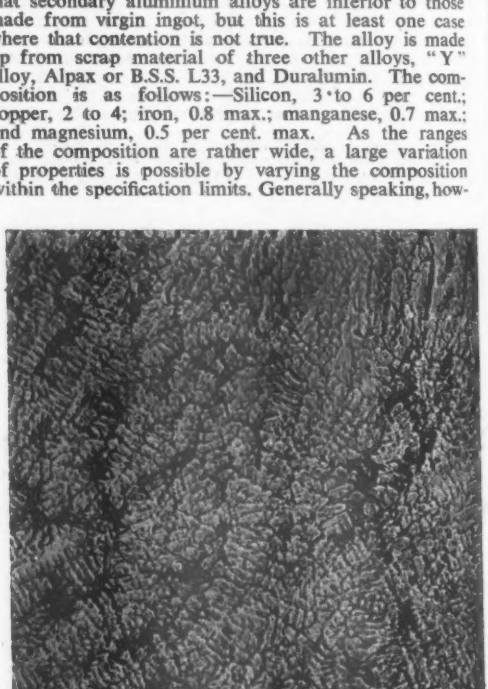

FIG. 4—MACROSTRUCTURE DTD 424 BEFORE MODIFICATION. UNETCHED. × 40.

ever, it may be said that the best results from both the moulder's and physical test inspector's point of view are given by a composition with the silicon content as high as possible, with the iron and manganese together equal to not more than 1.4 per cent. and a magnesium content of about 0.1 per cent.

Melted and cast in the conventional manner, the properties are not outstanding, the specification only calling for a minimum of 9 tons per sq. in. However, when the metal is treated according to a recent British patent specification, the properties are considerably improved. The treatment consists of fluxing the molten metal with a mixture of sodium chloride (*i.e.*, common salt), sodium fluoride and magnesium fluoride. Following this, the test-bars, when cast, are subjected to one of two treatments, according to the designer's requirements. The first is a low-temperature ageing treatment, which raises the tensile strength from 9 to 11 and 13 tons per sq. in. A high-temperature treatment at about 520 deg. C., followed by quenching and a treatment at low temperature, will raise the tensile strength to the order of 17 to 19 tons per sq. in., that is, as high as any other sand-cast and heat-treated aluminium alloy. Figs. 3 and 4 show some of the changes in structure which take place during these treatments. Thus an alloy which started life as a makeshift in order to use up available scrap material may well become important commercially in post-war work.

Duralumin

Since its discovery in 1906, many types and modifications of Duralumin have been developed, and it is still the most widely known and used of aluminium alloys, especially in the form of sheet and forgings, although it has been ousted from fashion as a casting alloy by "Y" alloy, and similar types. In the fully heat-treated condition, Duralumin may reach a tensile strength of between 25 and 30 tons per sq. in., this being about equal to that of mild steel. A standard typical composition is: Copper, 4 per cent.; magnesium, 0.5 per cent.; and manganese, 0.5 per cent.

In quite a different category are the binary alloys of aluminium with magnesium. They were developed as long ago as 1899 and given the name of magnalium, but were scarcely used at all until recent years, chiefly owing to the fact that the magnesium technique was not of a very high standard, and impurities were introduced into the alloy during the alloying procedure which caused the properties to be rather mediocre. However, with the increased knowledge of magnesium technique, this series of alloys was improved, and is fairly widely used at the present time. Magnesium has the effect of increasing the strength of aluminium and the alloys are very resistant to corrosive attack, even from sea water. They are employed in the form of sheet and castings for the construction of sea-going motor-boats.

The magnesium content of the alloys ranges up to 15 per cent. of magnesium and 1.5 per cent. of manganese, and are known familiarly under the names of Hydrolanium, MG7, Birmabright, Hyduminium RR66 and Peraluman. The alloy which conforms to the specification DTD 300 contains from 9.5 to 11.3 per cent. of magnesium, with small amounts of copper, silicon and iron, the interesting feature of this alloy being, to those familiar with the common magnesium-base alloys, that the composition is reversed. That is, where the aluminium alloy contains about 10 per cent. of magnesium, the magnesium-base alloy most commonly used contains 10 per cent. of aluminium. This fact, combined with a study of the equilibrium diagram, leads one to expect the heat-treatments to be similar, as in fact they are.

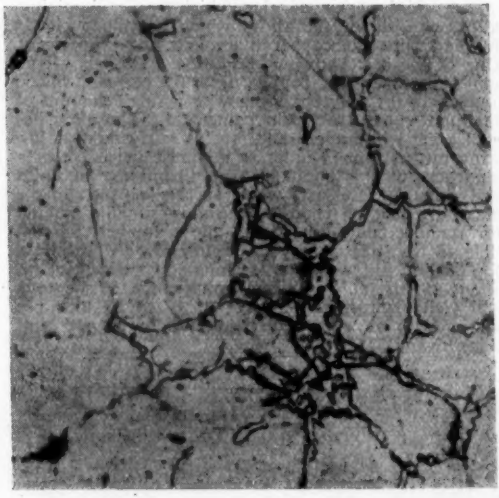

FIG. 5.—ALLOY CONTAINING 6 PER CENT. MAGNESIUM, SHOWING AL-MG. UNETCHED. × 300.

The best physical properties of DTD 300 are obtained by a treatment at 430 deg. C. for about 12 hours, following which the material is allowed to cool to about 390 deg. C. and quenched in warm oil or boiling water. The tensile strength will then be in the region of 17 to 18 tons per sq. in., with an elongation figure of 10 per cent. The specification calls for a minimum of 16 tons per sq. in. Satisfactory technique in the foundry may be achieved by a combination of aluminium alloy and magnesium alloy founding techniques; for instance, it is advantageous to use a flux cover during melting in order to keep oxidation to the minimum and prevent oxide inclusions.

High-strength Light Alloys

Research on high-strength light alloys has resulted in the development of alloys containing manganese and zinc, the zinc being present in such a quantity as to form a ternary compound with the aluminium and magnesium, *i.e.*, there is no free zinc in the alloy.

Aluminium Casting Alloys

The physical properties are remarkably good and in the "as-cast" state the strength is near 16 tons per sq. in. with a 15 per cent. elongation. When subjected to a simple ageing treatment, say, in boiling water, the tensile figure is raised to well over 20 tons per sq. in. Fig. 5 shows an Al-Mg alloy containing about 6 per cent. magnesium showing the Mg-Al compound.

DTD 304

The third series of these high-tensile aluminium alloys consists of the alloys which are made chiefly by the addition of copper in amounts up to 6 per cent. One of the best known is DTD 304. This alloy contains 4 to 6 per cent. copper, up to 0.9 per cent. silicon and up to 0.7 per cent. iron, with a small amount of titanium to assist in grain refinement. The alloy has a pleasing white appearance and is fairly fluid at low temperatures, but in order to minimise the effect of a tendency towards shrinkage, the liberal use of chills and risers is necessary, whilst success depends to the greatest extent on choosing the most suitable method for running and gating. The alloys are very susceptible to heat-treatment. For example, with heating at 535 deg. C., followed by quenching and a treatment for about 16 hrs. at a low temperature, the tensile tests will yield figures in the range of 19 to 20 tons per sq. in. with an elongation figure up to 10 per cent. (Figs. 6 and 7).

DTD 298

The alloy which conforms to specification DTD 298 has for all practical purposes the same composition as DTD 304, but the heat-treatment is limited to one stage consisting of a solution treatment at 530 deg. C. for 16 hrs., followed by quenching in hot water, which gives a strength of about 15 tons per sq. in. In this copper-aluminium series may be included DTD 250, RR 53c and "Y" alloy. The former, in addition to 2 to 3 per cent. copper, contains about 1 per cent. of nickel, iron and manganese, with minute amounts of cerium, columbium and chromium. It has rather a tendency to shrinkage and special care must be taken with design and method of manufacture, especially in die casting, or cracked castings will result. When treated at a temperature of 525 deg. C. for four to six hours, quenched in water and allowed to age-harden at room temperature for six days, the strength is in the region of 15 tons per sq in.

The next one, RR 53c, is a high-tensile alloy which has been popular for quite a period, especially for such parts as cast cylinder heads for aeroplane engines. It possesses quite good casting properties, although fairly heavily sectioned risers have to be used in order to minimise shrinkage. When heat-treated, the tensile strength is about 20 tons per sq. in., although this figure, together with the hardness, may be altered by modifying the ageing processes to suit the customer's requirements. Fig. 8 shows a typical structure of fully heat-treated RR 53c. It contains copper, nickel, iron,

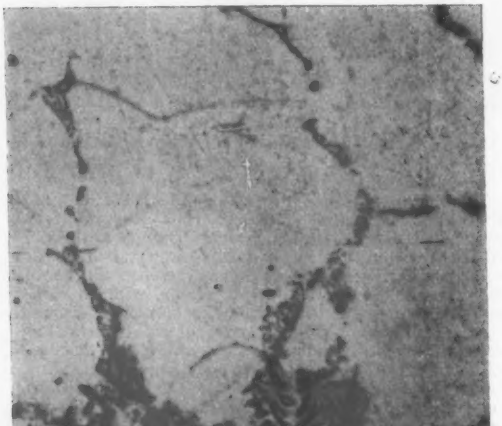

FIG. 6.—DTD 304 IN "AS-CAST" POSITION. CONSTITUENT VISIBLE MAINLY COPPER-ALUMINIUM. UNETCHED. × 300.

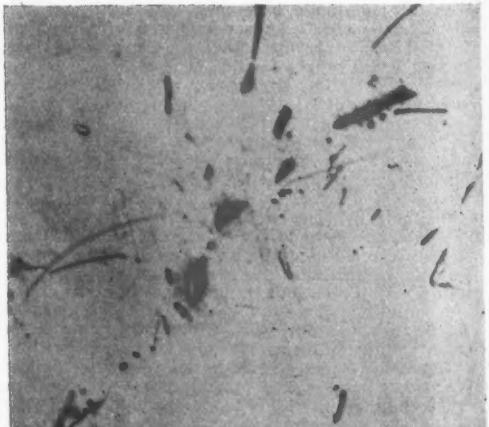

FIG. 7.—DTD 304 FULLY HEAT-TREATED. UNETCHED. × 300.

silicon, magnesium and titanium, the total amount of these elements present being about 7 per cent.

"Y" Alloy

"Y" alloy is a complex alloy which was developed at the National Physical Laboratory during researches on suitable materials for making parts to withstand working at the temperatures of internal combustion engines and at the same time possessing satisfactory

FIG. 8.—STRUCTURE OF SAND-CAST RR 53C, FULLY HEAT-TREATED. UNETCHED. × 300.

conductivity and low expansion coefficient, and, although it is not an easy alloy to cast, coupled with the fact that other alloys have been developed for similar purposes, other considerations cause it to retain its popularity for such parts as Diesel engine pistons. Its empirical composition is roughly as follows:—Copper, 3.5 to 4.5 per cent.; nickel, 1.8 to 2.3 per cent.; and magnesium, 1.2 to 1.7 per cent. The effect of nickel on aluminium alloys, in addition to improving the ordinary properties of the alloy, is to preserve these properties to a greater degree at the temperatures of internal combustion engines than alloys which do not contain nickel.

DISCUSSION

MR. H. J. V. WILLIAMS asked which alloys were used for dairy work, in view of the general assumption that corrosion was one of the drawbacks of aluminium.

MR. MORGAN said pure aluminium was very resistant to corrosion. Alclad sheet, consisting of a layer of Duralumin sandwiched between pure aluminium, had been developed for brewery and dairy tanks. He referred to the remarks on the properties of the magnesium aluminium-base alloy. Anodic oxidation was also employed.

MR. R. M. GEORGE asked whether anodising would prevent electrolytic action between aluminium and steel. He referred to aluminium cylinder heads containing steel studs.

MR. MORGAN said anodising would provide some insulation, as aluminium oxide possessed di-electric properties, but insulation or the complete exclusion of moisture would be desirable.

MR. LIST said that aluminium and stainless steel had been found to be a good combination.

MR. F. SUTTON asked which alloy would be most suitable for pressure-tight castings; he had tried several for castings to withstand air pressure and found that silicon-aluminium had been most successful.

MR. MORGAN agreed that silicon-aluminium was most suitable, probably owing to its possessing good casting properties and a low shrinkage. This should not prevent other stronger alloys being used, as in fact they were, given that the foundry technique was sufficiently highly developed to produce a sound casting. The secret of producing good castings in silicon-aluminium lay in the modification process. He had tried several methods, but preferred to rely on a method which employed a flux instead of metallic sodium. The radiological results were better and the test-bar figures were satisfactory; although some foundries managed quite well by over-modifying with metallic sodium and allowing the metal to stand before pouring until the correct stage was reached. This waiting period allowed gas present in the metal to evolve.

MR. A. L. PENDREY stated that success depended upon purity, *e.g.*, pure aluminium alloyed with 4 per cent. copper, 0.3 per cent. iron, 0.3 per cent. silicon would give excellent results. It was essential, however, to produce a good casting first time, as these alloys were very sensitive to impurity pick-up during successive remeltings. In this way the success of these alloys lay entirely in the hands of the moulder.

MR. WILLIAMS asked which was the lightest of the alloys referred to in MR. MORGAN'S address.

MR. MORGAN replied that, of the alloys which he had listed, the least dense normally would be the high-silicon alloys. The density of aluminium alloys varied between about 2.62 and 2.98 grms. per cub. cm. Die castings were more dense than castings of the same alloy in sand. Density could not be arrived at by simple arithmetical means when two metals were alloyed, *i.e.*, in a 50/50 mixture the s.g. was not usually the average of the densities of the component metals, although, generally, of course, the alloys which

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contained a high proportion of the heavier metals such as copper were more dense than alloys containing lighter metals.

MR. B. JONES asked for more details of modification of aluminium-silicon alloys by means of fluxes.

MR. MORGAN said fluid flux containing salts of sodium and potassium could be used at a temperature as low as 750 deg. C. The amount of flux used did not seem to be critical. Some foundries employed a more viscous flux and modified at a temperature above 1,000 deg. C. In this process it was not necessary to stir the flux into the metal. Although the results, as far as modification and gas occlusion were concerned, seemed to be satisfactory, the macrostructure was coarse, as might be expected.

MR. W. S. KINSMAN asked if there was any fixed formula followed in arriving at the size of risers employed in proportion to the dimensions of the castings.

MR. MORGAN said that, in his experience, this had not been done. He considered that every job had its own peculiarities and, although experience with jobs of a similar nature was certainly of use in laying down a technique for a casting, each one must be treated as an individual. The size of riser would probably vary as much with the general contour of the casting as with the section. The technique for making a casting should be thrashed out by the people concerned in a pre-production or experimental stage and, when satisfactory castings were produced, the job could be placed in the production shop with the detailed technique. The part to be played by the foundry supervision would be to see that the procedure was strictly adhered to throughout the entire process.

Vote of Thanks

A vote of thanks to Mr. Morgan was proposed by MR. SNUSHALL, in the course of which he stressed that strict control in all senses was well rewarded. It was known that research had resulted in improved properties for aluminium alloys during the war, and this would be followed by an expansion of the industry in post-war trade. The X-ray department, properly used, had become a necessary implement in the control that was essential to success.

PROF. W. R. D. JONES seconded, referring to aluminium as a relatively new and recently developed metal. An opportunity had been given to the company this afternoon of observing the measure of progress that had been made in the production of this metal and its alloys, although for some corrosion problems he considered stainless steel to be superior to aluminium. He was very pleased to second the vote of thanks to Mr. Morgan for his excellent Paper.

Written Communication

MR. E. J. KELLY wrote:—Could you please give the relative merits of sand and die-cast L33? Many of the castings seen had a high percentage of head metal. Have you any experience of the whirlgate head or atmospheric head on this type of casting? Mention was made by a member of the staff of the Northern Aluminium Company, Limited, that the success of L33 casting was dependent on the moulder. What are the main defects attributed to the moulder? The moulds were made in greensand and skin dried. Would the practice of moulding in cores assist the production of such castings? Such moulds would be free from moisture and, since the cores on view were of solid formation, no provision apparently being made to aid contraction other than the sand used is of an oil-sand mix, the question of a greensand mould to assist contraction does not arise.

In reply, the AUTHOR wrote: L33 is probably more widely known as an alloy for die-casting, its excellent casting properties, such as flowability, lending themselves readily to this application. Die-castings are generally more likely to be sound than sand castings without quite the same amount of care being exercised in the melting process, provided, of course, the running and risering technique is satisfactory, as the very process of die-casting tends to prevent the formation of pinhole porosity due to occluded gas. At the same time, the tensile properties are improved probably due to the finer and closer grain structure. The effect of heat-treatment is also considerably improved for the same reason. To anyone not used to light alloy founding, the risers employed might seem massive, but in most cases they were necessary; as for the ones on the castings seen that afternoon, I would prefer some member of the company to remark on them rather than myself. By whirlgate head I presume that the writer refers to the usual device which is inserted in the runner.

I have had experience of its use in connection with aluminium alloys, but there does not seem to be any especial advantage in it, and, for the most part, the foundry at which I work have discontinued its use. My experience has led me to believe that one rule which helps the running and feeding of aluminium-alloy castings is the incorporation of a riser immediately over the gate.

I think that Mr. Kelly has misunderstood the remark made by Mr. Pendrey in referring to the part played by the moulder. It is probable that the moulding technique to produce good castings was referred to, thus eliminating the repeated remelting of scrap metal leading to a deterioration in properties. The practice of mould in cores might be all right, but it cannot quite honestly be recommended from a point of view of economy and speed of production. I think that the answer lies either in rigid control of the properties of the sand, such as permeability, strength and moisture content, or, in the skin-drying of the moulds. Ordinary aluminium moulding sand was rather friable if the whole moulds were dried in the core stove, leading to dirty rough castings. The use of a mould or core wash containing an inflammable "carrier" which can be sprayed on the mould and core and ignited before closing the mould is sometimes recommended. The burning off skin dries the mould sufficiently if it is not left too long before pouring.

THE SCOPE AND LIMITATIONS OF RADIANT HEATING IN DRYING PROCESSES*

Methods which will find an important place in mass-production schemes

By H. SILMAN, B.Sc., F.R.I.C., A.M.I.Chem.E.

Sufficient experience has now been gained with the "infra-red" methods of drying and stoving to enable an assessment to be made of the possibilities and limitations of the technique. These methods have received their greatest application in the field of paint and varnish baking, with special reference to varnishes based on synthetic resins.

The earliest description of the use of directed radiated heat for paint baking was given by F. J. Groven[1] in 1935, who described the use of an installation of carbon filament lamps in gold-plated reflectors for the local drying of paints on motor-car wings, etc. (Fig. 1). The advantage of the method was that defects could be rectified by respraying and local baking without the need for dismantling the part concerned in order to pass it through a convection oven. The primary consideration here, it should be noted, was that the saving in labour involved by using this method was so considerable that even had there been no reduction in drying time, it would have been well worth while. It was then observed that apart from the convenience of the process, the time-saving element was considerable, and that very often synthetic varnishes could be dried in one-tenth or less of the time taken by the usual type of convection oven. It was therefore originally contended in some quarters that the infra-red radiation exerted some catalytic influence on paint drying by hastening polymerisation of synthetic resins as a result of the absorption of specific wavelengths.

Subsequent work has shown that there does not appear to be any evidence to substantiate this theory, and that the high rates of drying obtained by the infra-red method depend solely on the fact that heat transfer by radiation is much more rapid and efficient than heat transfer by convection. It can be said, broadly speaking, that the quantity of heat transferred by radiation is proportional to the fourth power of the temperature difference between the radiating surface and the receiver, whilst in convection heating the rate of transfer is directly proportional to the temperature difference. In actual fact these theoretical deductions are not strictly correct under practical conditions, but they are roughly true.[2] It follows therefore that it is to be expected that an article heated by direct radiation will attain a given temperature much more quickly than if heating is by convection, especially if a high temperature radiant source is used. Heat by radiation has the advantage also that the transfer of the heat is unaffected by the presence of insulating films of air at the surface of the article being heated; such films are known to hinder the rate of heat transference in convection ovens appreciably.

* Paper read at the Annual Meeting of the Institute of Vitreous Enamellers.

Tungsten Filament Bulbs

The first large-scale plants to make use of the remarkable reduction in the drying times of paint films resulting from the use of radiant heating were based on tungsten filament electric bulbs. These are

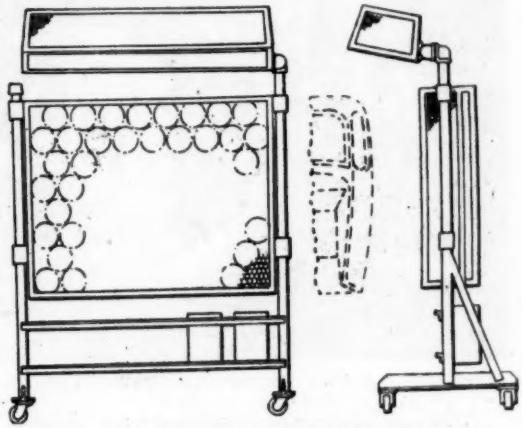

FIG. 1.—PLANT FOR THE LOCAL DRYING OF PAINTS ON MOTOR-CAR WINGS.

mounted either in trough-shaped reflectors carrying runs of lamps or in individual circular reflectors forming tunnels through which the painted articles can travel on a suitable conveyor. Portable units are also available for local heating, especially where dismantling of assemblies is to be avoided in the local drying of paint coatings. The principles and design of the electric bulb types of plant have been described by Maxted.[3] A typical plant is illustrated in Fig. 2, which shows a unit designed for the drying of paint on ammunition boxes. This is 9 ft. long and contains 378 lamps; current loading is 94½ kilowatts. Banks of trough reflectors are employed, and a detailed view of a typical bank

Radiant Heating in Drying Processes

is shown in Fig. 3. An alternative design of reflector bank in which separate reflectors are employed for each lamp is shown in Fig. 4.

As between the relative advantages of trough-shaped and circular reflectors, it can be said that the former enables a larger number of lamps to be mounted in a given space, resulting in a higher intensity of radiation on the object being heated, whilst the single lamp units have rather greater flexibility, enabling the radiation to be more evenly distributed.

Special bulbs are used for radiant heating plants, and in this country a standard wattage of 200 has been adopted as a wartime measure, although in the U.S.A. a variety of lamps are available with wattages of up to 1,000.

FIG. 2.—A UNIT DESIGNED FOR DRYING PAINT ON AMMUNITION BOXES.

Essentially, the tungsten filament bulbs used in these plants differ from ordinary lighting bulbs only in that they are slightly under run, so that a longer life is obtained than if a normal lighting service type of bulb were employed. The electric bulbs were originally mounted on bus-bars on an open type of framework; this resulted in simplicity of construction and accessibility of the plant. The tunnel shape could also be readily altered to suit different classes of work, whilst the whole assembly was also light and compact. The space occupied by such a plant was considerably less for a given output of many types of articles than would be a convection oven having a similar output, but there are instances where this is not so, as will be mentioned later.

No attempt was made at first to enclose the plant in any way, but this is being done to an increasing extent in more recent installations. The reason for the absence of an enclosing oven was probably based on the assumption that as the radiation is transmitted directly to the object being heated, the temperature of the intervening atmosphere is of no significance. Moreover, tungsten filament bulbs are highly efficient sources of radiant heat as can be seen from Table I, so that there appeared to be little advantage in endeavouring to maintain a high oven temperature.

A little consideration shows, however, that this conclusion is subject to the limitation that as the object being heated is itself constantly losing heat to the ambient atmosphere by convection (such articles not being usually very good radiators) if the air temperature within the oven is low these losses will become of considerable significance, and will substantially increase the time taken to heat the articles to a pre-determined temperature. This effect will be particularly noticeable towards the end of the heating cycle since it is then that the convection losses become highest if the air temperature is low, whilst, of course, the radiant heat input will not change appreciably throughout the heating period.

Energy lost by radiation from the heated surfaces is naturally not affected by air temperature, and may be reabsorbed by other articles in the tunnel and the heat utilised in this way. It can therefore be said that in most cases it is important to have a high air temperature within the oven, whatever the source of radiant heat, if the maximum efficiency is to be obtained.

Stoving of Paints and Enamels

The "infra-red" method of heating was primarily introduced in the last few years for increasing the rate at which it was possible to stove synthetic resin-based varnishes, and in this it succeeded admirably. The development of the process served to show, however, that there had previously been a fundamental misconception about the manner in which such paints dried. They had hitherto been supplied with directions that they be stoved for, say, half-an-hour at 350 deg. F. in a convection oven. The hardening of these enamels takes place mainly by a process of molecular polymerisation (unlike oil varnishes which harden largely by oxygen absorption). Polymerisation takes place relatively slowly at ordinary temperatures, but is enormously accelerated by heat. When a painted article is put into a convection oven at 250 deg. F., for a given period, therefore the time-temperature curve will approach the 250 deg. F. mark asymptotically. More-

over, if the article is of heavy cross-section the time taken for it to reach this temperature will correspondingly be greater than if the mass to be heated is smaller. It is, therefore, not possible to lay down a minimum stoving time for any particular paint without taking cognisance of the specific article to which

TABLE I.—*Heat Lost by Tungsten Filament Bulb by Conduction, Convection and Radiation.*

Method of heat lost by filament.	Percentage of energy input lost.	
	Vacuum bulb.	Gas-filled bulb.
Convection	0	20
Conduction along leads and supports	8	5
Total local heating ..	8	25
Infra-red radiation	86	67
Luminous radiation	6	8
Total radiant heat ..	92	75

it is applied. Even under the best conditions in a convection oven maintained at 250 deg. F., it is true to say that the varnish is only at or near this temperature for a relatively small proportion of the total processing time, and by far the greater part of the drying

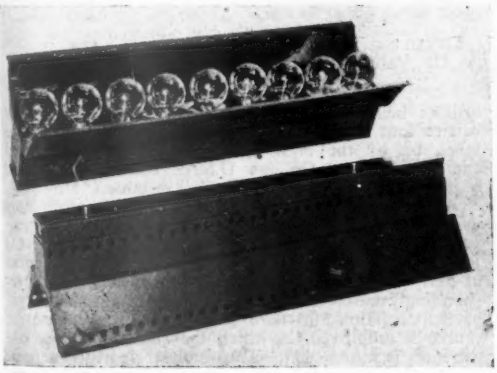

FIG. 3.—CLOSE-UP VIEW OF A BANK OF TROUGH REFLECTORS.

effect takes place within the very few minutes at which the temperature is between 200 and 250 deg. F. During the major part of the time in which the painted surface is in the oven little polymerisation is therefore taking place.

With radiant heating, on the other hand, the rate of heat input is rapid so that a high temperature is reached in a very short space of time; once a sufficient temperature for speedy transformation to occur is attained only a very few minutes are required for complete drying to be obtained. The main cause of loss of time in convection heating, *i.e.*, the long period during which heating up is taking place, is thus eliminated. The use of radiant heating, however, introduces a critical factor into the stoving process, *i.e.*, the stoving time. In heating by radiation, absorption of heat

FIG. 4.—SHOWING AN ALTERNATIVE DESIGN INCORPORATING SEPARATE REFLECTORS.

takes place rapidly and continuously, and the object being heated cannot be left exposed to the radiation for too long or the required temperature will be exceeded and the paint may be charred, or at any rate, discoloured. In the convection oven, on the other hand, the temperature of the radiation absorber cannot exceed that of the oven itself, and provided the stoving time is adequate little or no damage can occur if the time is exceeded.

In radiant heating the required time of stoving must be determined by experiment, and is affected by the size and mass of the object which affect the amount of heat which must be absorbed before an adequate temperature is attained. Naturally a massive metal article will take longer to attain a given temperature when exposed to a source of radiation than will a light object exposed to the same source.

Influence of Colour

Another factor which is of no consequence in convection heating, but of considerable significance where radiant heating is concerned is the colour of the object. Light colours, for example, do not absorb radiant heat so readily as do dark colours, a considerable proportion of the heat in the case of the former being reflected back. The difference in the times required for heating metal plates painted in various colours is shown in Fig. 5. Heating was effected by electric bulbs and by low-temperature gas heated radiating panels which are described below.

Sources of Radiation

Tungsten filament bulbs as sources of radiant energy have already been mentioned, and their high radiating efficiency and simplicity of installation have been pointed out. Electric lamp plants have played a very valuable part during the war, and have enabled paint stoving plants which occupied a relatively small space and were capable of high output to be rapidly installed.

Radiant Heating in Drying Processes

For normal commercial operation, however, electric bulbs as sources of heat have little to commend them, once it is realised that there is no particular virtue in the radiation from the bulb which has no catalytic effect on the paint; the main criteria as regard the usefulness of a source of radiant heat in this field are simply the installation and running costs of the heating unit and the speed with which heating of the article being dealt with can be carried out.

When examined from these aspects, several disadvantages in the use of electric bulbs as heating elements become apparent. These are (*a*) the relatively high initial cost of the electrical equipment and the appreciable bulb replacements, especially where large plants are concerned. The lamp caps are especially prone to fail because of the high temperatures to which they are subjected. (*b*) The lack of control of the source of radiant heat, as each bank of lamps can only be switched on or off; (*c*) the difficulty of replacing bulbs which have failed whilst the plant is in operation; (*d*) the labour required for the periodical cleaning of reflectors which must be kept in good condition; (*e*) the very low overall efficiency of the plant in relation to the power input due to high convection losses from the articles being heated; (*f*) the low energy input per square foot of surface being heated due to the space taken up by the bulbs and their relatively limited energy output. (In the U.S.A., however, infra-red bulbs of up to 1,000 watts are available.)

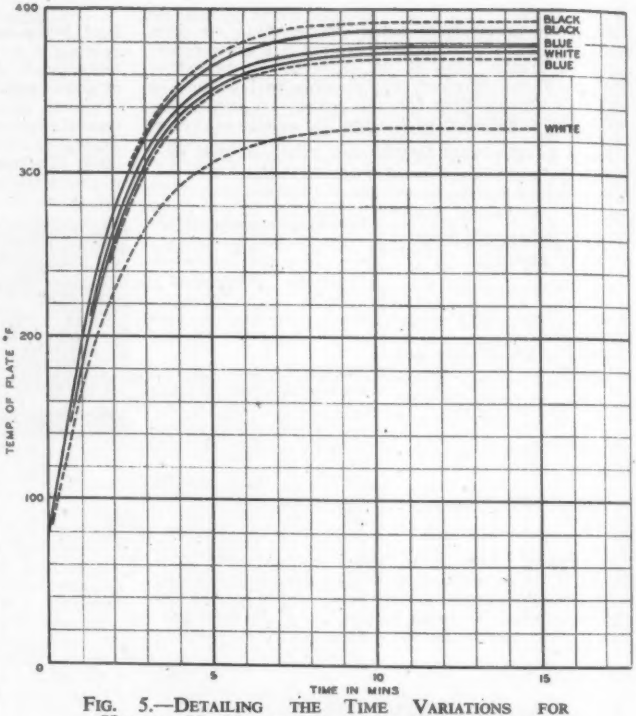

FIG. 5.—DETAILING THE TIME VARIATIONS FOR HEATING UP VARIOUS COLOURED METAL PLATES.

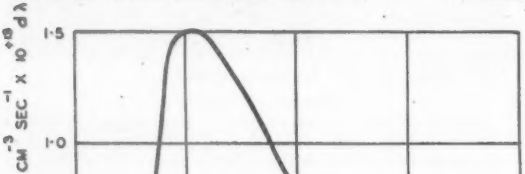

FIG. 6.—SHOWING THE ENERGY DISTRIBUTION OF "BLACK BODY" RADIATION AT TWO ELEVATED TEMPERATURES.

A further disadvantage of the tungsten filament lamp as a heating medium is that because of the high temperature at which it operates (about 2,000 deg. C.) there is a sharp peak in its infra-red distribution curve at about 1 μ. This means that there will be correspondingly narrower bands of radiation absorbed by a particular paint film than when a lower temperature source is employed, in which the spectral energy distribution is more even. This is seen clearly in Fig. 6. Practically all paints have absorption bands, which are fairly widely dispersed in the infra-red region, so that a flat energy distribution curve is desirable.

REFERENCES

[1] U.S. Patent 1,998,615 (1935).
[2] J. H. Nelson and H. Silman. "The Application of Radiant Heat to Metal Finishing." Chapman & Hall (1944), p. 11.
[3] R. Maxted. Trans. Illum. Eng. Soc. (London). (1942), 7, I.

(To be continued.)

RESEARCH AND THE VITREOUS ENAMELLING INDUSTRY

MR. G. H. ABBOTT, in a Paper which he presented before the annual meeting of the Institute of Vitreous Enamellers, held recently in Manchester, utilised the historical background of the industry to show research trends and results throughout the ages. At each stage the composition of the enamels was detailed. Finally the Author gave a bibliography of 167 references to the literature of the subject.

After its presentation, the following discussion ensued. Mr. W. Todd presided.

Hydrogen in Metals

MR. J. H. GRAY agreed with the statement in connection with the absorption of oxide into the bulk, as he had personally been carrying out some experiments, and in connection with hydrogen he had found that an amount of hydrogen had been absorbed into the metal. No doubt this had had quite a good deal to do with the absorption of oxide, but blistering had occurred also which was due to the composition of the ground coat.

Another matter in which he was interested was the fusing temperature of a sheet-iron coat. The fusing temperature was perhaps 100 deg. C. higher than the melting point of the frit. What was Mr. Abbott's view upon the matter? Did he think that the increased temperature for fusing assisted in the absorption, or whether it assisted in telling him when the ground coat was fused? In other words, was it a colour test?

Fusibility of Ground Coats

MR. ABBOTT congratulated Mr. Gray upon the closeness with which he had been able to follow the details of the Paper in the short time which had been available to him. The question of pickling and hydrogen absorption which C. A. Zapffe and Dr. J. L. Yarne had clearly demonstrated, a great deal of hydrogen was absorbed during pickling, and if it was not burnt out, as happened in the neutralising process, then much trouble would ensue later. Enamellers had been using the hot neutralising bath for a long time without realising that that was what was getting the hydrogen out of the steel.

He was not quite in accord with Mr. Gray respecting the fusibility of the ground coat, because he did not believe the ground coat had a melting point. It softened at ordinary working temperatures and remained liquid up to a temperature at which it could finally be volatilised, but it could not be fused by the metal below a temperature at which it would fuse in a reasonable amount of time. Time was the essential point. If left for several years, perhaps, at a lower temperature, then because of its nature it might spread out in a similar way to that in which a rod of glass would bend. The working temperatures of enamels were limited by practical considerations.

Colour in the ground coat was due not essentially to the colour of the ground coat itself, but to what was happening during the fusing process. There was a very large amount of iron oxide going into solution in the ground coat which altered its colour. As the firing continued so the amount of iron oxide increased, and the colour changed until it might become supersaturated by iron oxide and have a reddish colour.

MR. A. MCLEOD, referring to the joint investigation by C. A. Zapffe and C. E. Sims, wondered if there was a suggestion that the influence of hydrogen might be made a subject for a fundamental research.

MR. ABBOTT said he had not read the work of Zapffe and Sims as fully as he would like to have done. He noticed, however, that frequent reference was made to research work on gases, and to a book by Smithells on "Gases in Metals." He would regard the work of Zapffe and Sims and their collaborators in the Institute of Ohio as being really the answer to what Mr. McLeod had suggested. They had been working upon hydrogen in steels, and purely as metallurgists; they were not enamellers at all. If it had been brought to their attention that hydrogen might be the cause of certain defects in vitreous enamelling, and they were given an opportunity to carry out the research work, then the result might be to form a sort of technical course in vitreous enamelling.

Hydrogen from Pickling Processes

MR. BRADBURY referred to the statements contained in the Paper respecting hydrogen occlusions, and wondered whether Mr. Abbott could give any lead as to the effect of pickle concentration. That was as to how it would affect occlusion in steel and sheet iron; and also whether the use of hydrochloric acid in this country would tend to give a rather more serious hydrogen occlusion as opposed to the use of sulphuric acid. Would the use of suitable inhibitors reduce the tendency to hydrogen occlusion? In addition, what would Mr. Abbott consider to be reasonable in the case of the neutralising tank to remove hydrogen occlusion? He was aware that the general understanding of the periods in neutralising tanks was rather vague, but could any lead be given as to the minimum time to be recommended? It was known fairly definitely in other industries, particularly where galvanising was concerned, that hydrogen occlusion did definitely tend to cause blistering and, in many cases, weeks after actual galvanising had been carried out. Was there any dangerous concentration of hydrogen which must be avoided to prevent the hydrogen coming out of the steel at a later date and affecting the enamel?

MR. ABBOTT thought that, in order to answer Mr. Bradbury's point, the Institute should really promote a discussion on the work done with hydrogen, and that it should be opened by someone who was willing to carry out some of the simple experiments as demonstrations. He believed there was so much hydrogen present that it really did not matter what was the pickling procedure; whether there was a sulphuric acid or hydrochloric acid inhibitor, there would be plenty of hydrogen in the steel. Hydrogen contained in the steel was not hydrogen gas, but atomic hydrogen. The trouble commenced when it began to form a molecule of hydrogen, and hence bubbles.

A special point regarding hydrogen and vitreous

Vitreous Enamelling Industry

enamelling which had been demonstrated was that at the enamelling temperatures the solubility of hydrogen in steel was very much greater than it was at lower temperatures. There was the extraordinary phenomenon of hydrogen coming to the surface. With the change in the crystal structure of the iron there was more space for the hydrogen to be absorbed, it then tending to go back again and cause reboiling, etc.

It was suggested by the investigators that ten minutes should be the time in the neutralising bath. A piece of steel was put in boiling water, and it effervesced like soda water from a syphon for about ten minutes, when it completely subsided. The hydrogen was completely eliminated.

Mention had been made of the delayed action of hydrogen in the galvanising process. This effect had its counterpart in enamelling as fish-scaling. Delayed fish-scaling weeks afterwards had been shown to be accompanied by the evolution of a bubble of gas; where a chip of enamel came off, a bubble of hydrogen was evolved. This bubble could, in fact, be evolved with explosive violence, as had been shown with various types of hollow-ware. A perusal of previously published Papers would prove to be of fascinating interest in regard to their description of the points raised.

Electrolytic De-scaling

MR. N. P. EVANS had heard it stated by enamellers that sheet steel which had been, first of all, defectively enamelled and which had to be de-enamelled, seldom exhibited defects upon a second enamelling treatment. It occurred to him that this might possibly be due to the effect of de-enamelling in molten caustic soda.

He had done some work recently in de-scaling steel by electrolytic process in molten caustic soda. The question of hydrogen was investigated, and steel pickled in hydrochloric acid increased the hydrogen content. Steel which was de-scaled in molten caustic soda definitely had less hydrogen content than the original steel. This might be merely a temperature effect, in which case it could be expected to occur in straight de-enamelling and in molten caustic soda. It was a point which was perhaps worth investigating.

DR. DEUTSCH said, if the pickling process only removed the scale, or evenly removed it, and the base metal was only little affected, actually, most of the hydrogen development only commenced when the acid attacked the metal. The alkaline treatment did not react with iron under hydrogen development. It absorbed the iron-oxide scale, but had very little effect upon the metal. This would prevent any increase in hydrogen.

MR. ABBOTT remarked that pickling was not the only cause by which hydrogen could be evolved. Blisters on cast iron had been shown to be due to hydrogen inclusions, and hydrogen might come from water in any form which was reduced. It might come from water in the enamels, water in the clay, or hydrogen originally included in the metal, and so forth. Pickling was interesting, because it was easily demonstrated as a source of hydrogen.

More Fundamental Research

MR. TINSLEY put forward a plea for more fundamental research in the vitreous enamelling industry, and also in the ceramic industry. He had done a little work himself, and it had been borne in upon his mind how little any of them really knew about what was going on. He felt there had been merely a scratching of the surface of investigation possibilities; there was much remaining to be discovered. He would suggest that the Institute considered the possibility of fostering some sort of fundamental research. There were several ways of doing so. It could be done co-operatively. Very few members could command the facilities for conducting fundamental research, but if the efforts of all the individual laboratories could be correlated some useful results should be achieved.

Another way of carrying out fundamental research work was to qualify for the D.S.R.I. grant, and become a research association or foster a research association. A third way might be to promote some amalgamation between the various societies already in existence.

The CHAIRMAN thought that the discussion had really run away somewhat from the subject matter of the Paper. He thought on similar lines to Mr. Tinsley, and before long it was hoped by some of those present there would be sufficient interest stimulated in the enamelling industry as a whole to set up a research association of their own. They might then be more in a position to insist upon collaboration with the other bodies which had been mentioned during the course of the discussion.

He then proposed that a hearty vote of thanks be accorded to Mr. Abbott for his Paper. When they had all studied it in detail, then, if written criticisms were sent in to the Council, Mr. Abbott would be pleased to reply to them.

The vote of thanks was carried unanimously by acclamation.

NOTES FROM THE BRANCHES

CAPE TOWN SECTION.—Members and their wives were the guests of the President, Mr. L. Rowley, for afternoon tea on December 17, at his home at Plumstead. The November meeting was devoted to the discussion of members' problems. They covered a wide range, varying from die-casting production, through a pulley and casing cast integral, aluminium bronze, manganese bronze, tin sweat, black spots in aluminium castings to pattern warping.

DR. O. F. HUDSON has retired from the staff of the British Non-Ferrous Metals Research Association. Formerly Research Superintendent, Dr. Hudson had been retained during the last five years in a part-time capacity as consultant and literary adviser.

EXPORTS OF IRON AND STEEL IN 1944

The Board of Trade has now published figures of exports of iron and steel in 1944 (see table below). For the figures for the earlier war years see the JOURNAL for November 16, 1944, page 224, and December 21, 1944, page 327.

Total Exports of Iron and Steel and Manufactures thereof in 1944.

To	Tons	£
Eire	15,146	568,117
Palestine	3,194	122,873
Brit. W. Africa	8,006	346,287
Union of S. Africa...	17,154	813,650
N. Rhodesia	6,132	195,031
S. Rhodesia	9,220	211,165
Brit. E. Africa	3,246	147,767
Sudan	2,095	62,797
British India	18,860	922,431
Burma	—	—
British Malaya	—	—
Ceylon	3,415	105,689
Hong Kong	—	—
Australia	8,671	555,932
New Zealand	6,521	444,288
Canada	659	96,872
Brit. W. India Is.	1,115	69,551
Oth. Brit. Countries	2,190	128,650
Iceland	455	30,619
Dutch E. Indies	—	—
Dutch W. India Is.	301	21,989
Portuguese E. Africa	175	10,243
Egypt	9,397	238,700
Iraq	1,893	63,507
Iran	57,149	1,745,830
U.S.A.	27,304	453,741
Chile	25	3,298
Brazil	90	14,629
Uruguay	22	4,089
Argentine	177	27,247
Oth. For. Countries	16,863	1,100,077
Total	219,475	8,502,669

ANTIMONY HAS BEEN RETURNED to strict allocation controls in the United States; it had been on the "free" list since December 4, 1942.

MEMBERSHIP OF THE American Foundrymen's Association at June 30, 1944, was 6,620—a new record. There are now 27 local branches of the Association.

THE STEEL COMPANY OF CANADA, LIMITED, propose to erect at their Hamilton works a modern 51-in. strip mill for the production of sheets and tinplate. This plant will represent an expenditure of approximately $8,000,000. The new mill will hot-roll steel from plate thicknesses down to sheet gauges of 0.050 in. in thickness, with delivery speeds up to 2,000 ft. per min., and in continuous lengths of 1,300 ft. or more.

DISTR'BUTION OF INDUSTRY

PROVISIONS OF NEW BILL

The Distribution of Industry Bill confers wide powers on the Government to influence the location of new industrial development. The special purpose of the Bill is to provide more varied employment in the former "special areas," which are to be extended and renamed "development areas," and various inducements will be offered to industrialists to establish new enterprises there. The Bill further provides for the prohibition in certain areas of the erection or extension of industrial buildings without Board of Trade approval.

The Special Areas (Development and Improvement) Acts will be repealed, and the responsibilities of the Commissioners taken over by the Government. With important extensions to make them include whole industrial regions of which they were a part, these areas will be known as the North-Eastern, West Cumberland, South Wales and Monmouthshire, and Scottish development areas. In these areas the Board of Trade may acquire land for factories and means of access to them. There will be considerably more trading estates in the development areas, with special facilities for light industries.

Provision is made for various methods of financial help to stimulate industrial development in these areas. To further the provision of industrial premises, Government loans may be made to non-profit-making trading or industrial estate companies. The Treasury may make annual grants or loans to help temporarily in meeting capital expenditure on new industrial undertakings in development areas where there are initial handicaps to be overcome. The Bill calls for notification to be made to the Board of Trade of all proposals to erect anywhere in the country industrial buildings with an aggregate floor space exceeding 3,000 sq. ft., and forming part of a new industrial unit. The Board may by Order prohibit the erection or extension of industrial buildings with an aggregate floor space exceeding 3,000 sq. ft., except with permission, in any area where the provision of further industrial premises "would be seriously detrimental to the proper distribution of industry." Any such Order will require approval by affirmative resolution of each House of Parliament.

These two provisions together will enable the Government to influence the location of new industrial development in a manner similar to that contemplated by the Barlow Report. Account will be taken of strategic as well as of industrial and social considerations, and one aim will be to disperse essential industries.

APPARENTLY THERE IS Continental competition for some of the American prefabricated houses. According to the "Iron Age," for the dismantled units of the Pineacres housing project at Niagara Falls there have been offers from Belgium and France as well as this country.

NEWS IN BRIEF

THE AGRICULTURAL MACHINERY DEVELOPMENT BOARD for Great Britain has completed its initial three-year term of office, and has been reconstituted. Lord Radnor will continue to be chairman.

HORSESHOES, machinery belt fasteners and cutlers' steels have been removed from the Schedule to the Export of Goods (Control) (No. 10) Order, 1943, and consequently require a licence only when exported to those destinations to which the export of all goods is controlled.

IT IS UNDERSTOOD that inquiries are being made by the Department of Overseas Trade and the Board of Management of the Birmingham Fair at the Chamber of Commerce, as to the likely support from manufacturers if a British Industries Fair is arranged for a date between late February and June of next year.

IT WAS STATED at a meeting of Glasgow Corporation that the Housing Director had been in touch with various firms on the question of steel alternatives to the Portal house. Negotiations were now taking place with Lord Weir's firm on the possibility of building permanent steel houses suitable for local needs.

BROOM & WADE, LIMITED, manufacturers of air compressors, etc., of High Wycombe, have applied to the Capital Issues Committee of the Treasury for permission to issue a part of new ordinary shares at a premium. If permission is granted, particulars of the offer will be circulated to ordinary shareholders.

AT A MEETING of over 2,000 engineers, held under the auspices of the A.E.U. in Glasgow recently, the transition of industry from war to peace was discussed. A resolution calling on the Government to produce a plan for the change-over, and to achieve it without unemployment or redundancy, was unanimously approved.

MARINE STEAM TURBINE research work will be carried out at an experimental station which is being erected on land adjoining the Wallsend works of the Parsons Marine Steam Turbine Company, Limited. The scheme is being carried out by the Parsons & Marine Engineering Turbine Research and Development Association.

THE FEDERATION OF BRITISH INDUSTRIES have denied a report which appeared in a London morning newspaper that an organisation to be known as the Congress of British Employers' Organisations was being planned by leading employers' organisations. The British Employers' Confederation, the National Union of Manufacturers, and the National Chamber of Trade, which were also mentioned as parties to the plan, have also denied the report.

GOVERNMENT ADVICE to industry about the planning of holidays this year is that, subject to the overriding needs of the war situation and the claims of production and of essential services, (*a*) industrial agreements and common practice in relation to the annual holiday should continue in general to be observed; (*b*) the same days as last year should generally be approved holidays. Staggering of holidays is more than ever necessary, it is added.

MR. H. J. HAGGAR, Chief Ship Surveyor to the Ministry of War Transport, who is retiring after 50 years of continuous service under the Crown, said recently that the introduction of wholesale welding in lieu of riveting was presenting new and interesting factors in the building of ships, and there was a wide scope for its adoption in ships of the future. At the same time, there was a good deal of scope for welding research before an efficient all-welded ship could be produced.

ADDRESSING MEMBERS at the annual meeting of the Manchester Chamber of Commerce, recently, the president, Mr. A. H. S. Hinchliffe, said all of them wanted to know in greater detail the lines of Government policy in the matter of British export trade. They were very much in the dark, and a lot of lip service was being paid to the need for a 50 per cent. increase over pre-war exports without the essentials being revealed. Among the questions they wanted answered were:—What priorities will be laid down for different industries? What will be the division between home and export trade? Will there be free access to essential raw materials? Will labour be available at the right time? A proper balance between the allocation of the necessary plant, labour and raw materials would be essential to success. Those were the main ingredients of a successful export drive. At present they were controlled by different Government departments, all of which needed to keep in step.

ACQUISITION OF IRON AND STEEL PRODUCTS

The Minister of Supply has made the Control of Iron and Steel (No. 39) Order, 1945, which came into force on February 26. The Order extends the list of iron and steel products of which limited quantities may be acquired by any person without licence and also increases the quantities. It also permits stockholding merchants to acquire, without licence, limited quantities of wire and certain wire products. The Order also permits any person to acquire, without licence, any quantity of cemented carbide hard metal.

The Minister has also made the Control of Bolts, Nuts, Screws, Screw Studs, Washers and Rivets (No. 7) Order, 1945, with effect from the same date. The Order removes the control of the acquisition and disposal of bolts, nuts, screws, screw studs, washers and rivets when such articles are acquired by any person for his own use, and a licence or authorisation is no longer required. The order also permits certain purchases without licence by merchants and stockholding merchants, although, in general, the provisions in regard to acquisition by stockholding merchants remain unchanged. It also permits a person who previously had sold the articles in question to any other person to buy them back from that person without licence.

Copies of the Orders may be obtained from H.M. Stationery Office, York House, Kingsway, London, W.C.2.

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COMPANY RESULTS

(Figures for previous year in brackets.)

Darlington Railway Plant & Foundry—Interim dividend of 5%.

Braithwaite & Company Engineers—Interim dividend of 3% (same).

Bruce Peebles—Ordinary dividend of 5% (same) and a bonus of 3% (same).

Guest Keen Baldwins Iron & Steel—Dividend of 6% (same) for the year to December 31 last.

L. Gardner & Sons—Profit for 1944, after depreciation, taxation, etc., £47,059 (£51,555); to preference dividend, £5,041 (same); ordinary dividend of 50% (same): forward, £248,304 (£240,373).

Clarke, Chapman—Net profit for 1944, £107,402 (£96,038); ordinary dividend of 12½% (same); to pensions reserve, £20,000 (£10,000); to general reserve, £20,000 (same); forward, £41,414 (£38,902).

Redpath, Brown—Net profit for the year ended July 31, 1944, £49,952 (£44,730); preference dividend (net), £5,250 (same); ordinary dividend, tax free, £44,702 (£39,480); forward, £172,244 (same).

M. Mole & Son—Profit for 1944, £31,180 (£40,133); taxation, £18,549 (£27,374); net profit, £7,995 (£7,940); dividend of 10%, plus bonus of 2½% (same); to contingencies reserve, £2,500; forward, £8,039 (£7,751).

Lancashire Steel Corporation—Dividend of 7%, less tax, for the year ended October 31, 1944, on the "A" and "B" ordinary stock (7% per annum, less tax, for the 10 months' period ended October 31, 1943).

Crosthwaite Furnaces & Scriven Machine Tools—Profit for 1944, after depreciation, directors' fees, employees' bonus, tax, etc., £4,001; dividend of 10%, £2,448; bonus of 5%, £1,224; to general reserve, £500; forward, £2,549.

Broom & Wade—Trading profit for the year ended September 30, 1944, £256,685 (£237,533); depreciation, £20,810 (£20,306); tax, £199,243 (£161,772); net profit, £36,633 (£55,455); deferred repairs, nil (£32,879); preference dividend, £3,450 (same); ordinary dividend of 22½%, £16,875 (same); to general reserve, £17,692 (nil); forward, £32,333 (£33,718).

East Pool & Agar—Tin concentrate sold in 1943, £138,031 (£109,563); other receipts, £331 (£397); to mine development, £24,120 (£20,058); underground working, £68,105 (£45,773); treatment, etc., £31,487 (£27,858); profit, £5,769 (£8,106); to depreciation of machinery and plant, £2,221 (£2,517); debenture interest, £1,142 (£1,663); surplus, £2,407 (£3,926); debit forward, £24,933 (£27,340).

AS A RESULT of prospecting work carried out by the Geological Survey, fresh deposits of bauxite of a somewhat superior grade to those previously mined in Ireland were located, said Mr. V. A. Eyles, in an address to the Edinburgh Geological Society on "Tertiary Bauxite and Iron-ore Deposits in Northern Ireland." He said that mining operations had ceased entirely in Northern Ireland before the outbreak of the present war, and in 1940 the capitulation of France cut off one of our main sources of bauxite, making it necessary to seek new deposits.

PERSONAL

MAJOR B. C. TALBOT has been elected a director of Steel Developments, Limited.

MR. R. J. HUNT has joined the board of Ransomes, Sims & Jefferies, Limited, engineers and ironfounders, of Ipswich.

SIR WILLIAM LARKE, director of the British Iron and Steel Federation, has undergone an operation in London. His progress is understood to be satisfactory.

MR. MARK BRAND, a director of William Baird & Company, Limited, since 1918, has resigned. SIR FREDERICK C. STEWART and MR. HUGH C. WATERSTON have been appointed directors.

PROF. DOUGLAS HAY, M.C., B.Sc., has been appointed to be a member of the Board for Mining Examinations in succession to the late Mr. Robert Clive. Prof. Hay is a Professor of Metallurgy in Glasgow.

MR. GILBERT VARLEY, works director of Platt Bros. & Company, Limited, textile and general engineers, of Oldham, Lancs, has been elected a member of the Council of the Institution of Mechanical Engineers.

MR. H. C. WILSON BENNETTS, a director of General Gas Appliances, Limited, a subsidiary company of Allied Ironfounders, Limited, has been appointed to the board of the parent company and will assume the duties of technical director.

MR. A. E. L. CHORLTON, M.P., owing to pressure of other business, has resigned the position of chairman and director of Lancashire Dynamo & Crypto, Limited. MR. H. W. BOSWORTH, managing director of the company, has been appointed chairman.

SIR ALEXANDER DUNBAR and MR. F. LEACH have resigned from the board of Taylor Bros. & Company, Limited, Trafford Park Steelworks, Manchester. MR. A. G. E. BRIGGS and MR. C. H. DUNT have been appointed directors. Mr. Dunt will retain his position as secretary.

MAJOR H. J. W. MARSH, who was killed in action in Italy, in September, 1944, has been posthumously awarded the Military Cross. He was a director of the Sheffield firms of Marsh Bros. & Company, Limited, steel and tool manufacturers, Spear & Jackson, Limited, tool manufacturers, and the Effingham Steel Works, Limited.

MR. T. S. PEACOCK, deputy chairman of Guest, Keen & Nettlefolds, Limited, at the Darlaston works recently, presented long-service certificates and cheques to 39 employees whose services in the aggregate amounted to over 1,340 years. Among them were four men with 50 years' service and two women with 40 and 30 years respectively.

MR. WILLIAM H. HIGGINBOTHAM has been appointed chairman of Edgar Allen & Company, Limited, in succession to MR. C. K. EVERITT, who died last month. Mr. Higginbotham joined the company in 1930 as secretary (a position which he now relinquishes) and became a director in 1933. He has since been in charge of the financial side of the company's activities.

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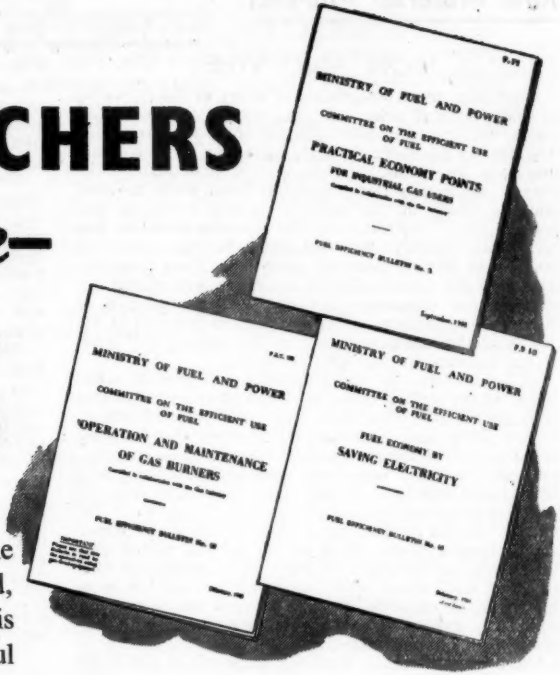
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ISSUED BY THE MINISTRY OF FUEL AND POWER

Raw Material Markets

IRON AND STEEL

There are many complaints of delay in the deliveries of metallurgical coke. In this respect the blast furnaces are less seriously affected than the foundries. The fuel is available; in fact, there are large accumulations at the ovens, but transport is inadequate. Pig-iron production is fairly constant from week to week and the whole of the make is passing promptly into consumption. Applications for licences have to survive close scrutiny, but reasonable tonnages are still obtainable for all essential purposes. Only hematite iron is really scarce and this condition has existed for so long that consumers are now well accustomed to the use of substitutes. Some expansion is noted in the call for ferro-manganese, but in this respect the needs of the steelmakers are well cared for.

The slackening of the pace of operations at some of the heavy rolling mills has enabled the steelmakers to maintain at a high level their deliveries of billets, blooms, slabs and sheet bars. Re-rollers also continue to use all the defective material which comes on offer, and have not of late been inconvenienced by any shortage of supplies. If the steel mills were restored to full-scale operations, it is, however, very doubtful whether British production of semis would be adequate for all requirements. Both in the pre-war period and during the earlier years of the war, considerable tonnages of steel semis were imported and, so far as is known, steel capacity in this country has not been sufficiently expanded to be able to dispense with imports in all circumstances.

There are still many finishing mills which are fully employed. Bookings for small bars and light sections are only on a slightly reduced scale, and the maximum tonnages of steel arches, bars and props are required for colliery use. Demand for steel rails is also on such a scale as to ensure a steady run for the mills for months to come, while it is already difficult to place an order for light sheets for delivery earlier than Period III. The most disappointing feature of the steel trade is the contraction in the volume of orders for steel plates, heavy and medium joists and sections. This chiefly arises from the lack of shipbuilders' specifications, and the quickening of activity at the shipyards would be a most welcome development.

NON-FERROUS METALS

Demands of the war factories in this country for the non-ferrous metals are still being met with, presumably, a margin to spare. The position in the United States would seem to be rather different, for there is a keen demand over there for copper especially, and the tendency has been to cut down the allocations to manufacturers of peacetime products.

According to an official of the U.S. War Production Board, arrangements are being made for increased U.S. imports of copper from Rhodesia, the Belgian Congo and Canada during 1945. An additional 4,000 workers will be needed in the United States to maintain the present domestic copper production rate of 73,000 tons monthly, he added.

In Britain there has been no further relaxation of the restrictions except in the case of aluminium. It is not too difficult to get copper, lead and zinc for purposes not directly keyed to the war effort, but labour and other considerations prevent a large tonnage of metal flowing in these directions.

The changes in the marketing arrangements for aluminium announced last week represent a further step towards the final freeing of this metal from wartime restrictions. Aluminium is now quoted at virtually the same price in Britain as in Canada and the United States. Most observers, however, believe that the current level is still a good way above the post-war valuation of the metal. Ultimately, a price between £50 and £60 per ton is visualised.

The Minister of Supply has made the Control of Non-Ferrous Metals (No. 16) Order, 1945, which came into force on February 26. This Order raises the maximum price of black hot-rolled copper wire rods not less than ¼ in. nor more than $\frac{5}{16}$ in. in dia. from £65 15s. to £66 10s. per ton. Copies of the Order may be obtained from H.M. Stationery Office, York House, Kingsway, London, W.C.2, price 1d.

The Non-ferrous Metals Control has informed the London Metal Exchange that, with certain exceptions, supplies of non-ferrous metals and ores for the European liberated countries will be obtained from producers through the normal commercial channels, subject to limiting instructions as regards quantities and areas of supply, from the Combined Boards in Washington.

OBITUARY

MR. JOE URMSTON, ironfounder, of Welbeck Street, Ashton-under-Lyne, Lancs, has died at the age of 74.

MR. L. J. KAYE, a director of Alfred Herbert, Limited, machine-tool makers, of Coventry, died recently.

MR. JOHN ALEXANDER COOK, who was associated for 42 years with Ruston & Hornsby, Limited, died on February 22, aged 75.

MR. R. DE VERE GREEN has been killed by enemy action in the South of England. He was managing director of W. B. Bawn & Company, Limited, sheet-metal workers and welders.

MR. JOHN SIDNEY SMITH, of Shifnal, has died at the age of 80. He was with the Horsehay Company, Limited, engineers and ironfounders, for over 60 years. When the company became a limited company in 1900, he was made secretary. In 1934 he became a director.

MR. DAVID WEIR, who had represented the British Thomson-Houston Company, Limited, of Rugby, for several years on various sections of the British Electrical and Allied Manufacturers' Association, and the International Electrical Association, died recently, aged 56.